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ESTIMATES OF DISTANCE.

HERBERT NICHOLS, in his experiments on "The Psychology of time" (*American Journal of Psychology*, April, 1891), has shown that estimates of time intervals are influenced by immediately preceding estimates, so that, in general, intervals are judged to be longer after practice on estimating an actually longer interval than when no such practice precedes, and shorter after practice on a shorter interval. The experiments about to be described were undertaken to see whether the same rule applies to estimates of distance. They show no such effect, perhaps because the intervening practice was not sufficiently sustained to affect the judgment. But the results are interesting for several reasons, and they are therefore given below.

The mode of experimenting was as follows: On each of three sheets of unruled paper (about six by nine inches) was placed a pair of pencil dots; on the first these were 4.02 inches apart; on the second .92 of an inch; on the third exactly the same distance as on the first. Without being told the object of the experiments, the person to be experimented on was shown the first pair of dots, allowed to look at them as long as he pleased, and then, the paper being taken away, told to make from memory, on a slip $9 \times \frac{1}{2}$ inches, two dots at the same distance apart, as nearly as he could. This was repeated on a fresh sheet, without his looking at the model again, and so on till he had made ten trials. The same thing was then repeated with the second and third sheets.

The following table shows the results, the first column giving the difference between the actual distance of the dots and the average of the ten estimates in each series; the second column the percentage of this difference to the actual distance; the third the mean deviation of the estimates from the average (taken always as positive); and the fourth the percentage of this mean to the actual distance. All distances are in decimals of an inch.

Persons.	Error of Average.			Per Cent.			Mean Deviation from Average.			Per Cent.		
	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.
S. S....	+.65	−.17	+.92	16	16	23	.13	.04	.12	3	4.5	3
J. S....	−.10	+.21	+.70	2 5	23	17	.14	.13	.14	3	14	3
A. L. B.	−1.35	−.30	−1.31	33 5	33	32.5	.14	.07	.25	4	5	6
E. S....	+.26	+.31	−.19	6	33	5	.31	.09	.23	8	10	6
L. B...	+ 75	+.18	+.68	19	19.5	17	.24	.04	.26	6	5	6
M. S....	−.31	+.20	+.45	8	21	11	.17	.09	.28	4	9	7
L. F....	+.05	+.07	−.01	1	7.5	0.2	.09	.04	.06	2	4	1.5

The degree to which the absolute value of the errors depends on previous training is plainly shown; for instance, L. F., in whose case they are remarkably small, is the daughter of a well-known artist and herself accomplished in the use of the pencil, while A. L. B. is a boy five years of age. The consistency of the estimates seems, however, to depend much less on training, as shown in the third column, the ratio of A. L. B's. mean deviations to those of L. F. being about 1.5, 1.7, and 6.8 for the three series respectively, while the ratios of their errors (from the first column) are 27, 4, and 131. In the cases of S. S., A. L. B., and L. B. the errors are nearly proportional to the actual length of the intervals, which would seem the natural rule; but in the other cases there seems a tendency toward making errors of the same absolute value in estimating both short and long intervals. A. L. B., whose absolute errors are far the largest, keeps them most nearly proportional. The mean deviations are much more generally proportional to the intervals, the most noticeable exception being that of J. S.—also the chief exception to proportionality in the former case.

ARTHUR E. BOSTWICK.

THE LATEST ADVANCES IN SPECTRUM PHOTOGRAPHY.

A LETTER just received by the present writer from Mr. Victor Schumann of Leipzig, whose work in the domain of spectrography is less widely known and appreciated than it deserves to be, reveals such surprising advances within the past year in photographing radiations in the ultra-violet spectrum, that I am impelled to present the following summary of Mr. Schumann's results.

More than two years ago he demonstrated the remarkable absorptive effect of air upon very short vibrations, so great, indeed, that even the air within the tubes of the spectrograph was a serious obstacle to the investigation. However, he was able, with the apparatus then at hand, to demonstrate the existence of lines up to and beyond wave-length 1,852 by photography, using the light of the aluminum spark.

With the fine skill and ingenuity which has ever characterized his work, Mr. Schumann has since constructed a spectrograph exhausted of air, with lenses and prism of white fluor-spar. The source of light for these researches was the hydrogen Geissler tube. With the "exhausted spectroscope," as it is termed, and plates of proper sensitiveness, Mr. Schumann finds the photographic action of the spectrum beyond wave-length 1,852 very strong indeed. It is composed of fourteen groups of lines, including altogether about six hundred lines. The boundary of this hitherto en-